## REMARKS

Claims 5-22 are pending in this application. Applicants acknowledge the Office's acceptance of the receipt of all certified copies of the priority documents. Reconsideration of the subject patent application and allowance of the claims are respectfully requested in view of the following remarks.

***Claim Rejections Under 37 C.F.R. §102***

Claims 5-7, 10-13, 16-19, and 22 are rejected under 35 U.S.C. §102(b) as being anticipated by Saida *et al.* (U.S. Patent 5,674,611) (hereinafter referred to as "Saida"). The Examiner cites Saida as teaching a process for producing a copper clad laminate providing an insulation layer constituent material having a first and a second side, coating the first side with a first copper foil of a first thickness, coating the second side with a second copper foil of a second thickness to produce a first copper foil/insulation constituent material/second copper foil assembly, wherein the thickness of the second foil is greater than the thickness of the first foil, hot pressing the assembly to produce the laminate, wherein the first copper foil is not recrystallized during the hot pressing, and the second copper foil is recrystallized during the hot pressing. The Examiner further argues that Saida discloses the thickness of the second foil as four times or less than the thickness of the first foil, the insulation layer constituent material is a resin, and after hot pressing the Young's modulus of the first copper foil is 1.1 times more than the Young's modulus of the second copper foil.

Applicants respectfully disagree that claims 5-7, 10-13, 16-19, and 22 are anticipated by Saida. In order for a proper anticipation rejection to have merit, the reference cited must describe each and every limitation of the claims. MPEP § 2131.01. Saida fails to disclose each and every limitation of the claims of the present invention because Saida does not refer to "recrystallization" of a second copper foil during hot pressing. "Recrystallization" in metallic materials is generally said to be as follows. When metals subjected to cold working are heated, strain energy accumulated inside the metals after the working is released and will return to a pre-

worked state. At relatively lower heating temperatures, recovery such as coalescence/annihilation of dislocation or polygonization occurs, and when the heating temperature becomes higher, new crystals free of strain will be generated, and metals will get soft. Such a phenomenon is called "recrystallization." *See* Shackelford, James F. *Introduction to Materials Science for Engineers, 2nd Edition*, p. 273 (1988) (copy attached for the Examiner's convenience). Independent claims 5, 11, 17 and claims 6, 7, 10, 12-13, 16, 18-19, 22 dependent thereon require that the first copper foil not be recrystallized during hot pressing, the second foil is to be recrystallized during hot pressing, and the second copper foil is greater in thickness than the first copper foil. The term "recrystallized" as claimed relates to a physical property of the copper foil itself. As described in the present specification, a copper foil incorporating strain within the copper foil (i.e., a rolled copper foil and an electrodeposited copper foil referred to as S-HTE) will likely cause a recovery phenomenon when heated, and new crystals free from strains will be easily generated. Both the rolled copper foil and S-HTE copper foil are copper foils that are easily recrystallized. The present invention exemplifies the rolled copper foil and electrodeposited copper foil as "recrystallizable" copper foils.

The Examiner points to column 1, lines 10-54 for support that Saida discloses recrystallization during hot pressing. Applicants submit that the relevant paragraphs only disclose technologies of nodulation treatment and black oxide treatment. The nodulation treatment (i.e. surface roughing treatment) and black oxide treatment are described as concerning adhesive properties with respect to a substrate, and have nothing to do with "recrystallization" of a copper foil. Saida provides an adhesive and a copper foil with an adhesive thereby disclosing high adhesiveness between a copper foil and a substrate. Additionally, Saida teaches only an adhesive with which the copper foil is adhered to the substrate, or the copper foil with an adhesive to be adhered to the substrate. There is no teaching in Saida concerning physical properties of a double-sided copper foil which constitute a double-sided copper clad laminate of the present invention.

Additionally, the Examiner asserts that Saida discloses at column 5, lines 9-52 that the Young's modulus of the first copper foil is 1.1 times more than the Young's modulus of the second copper foil. However it is difficult to see such a description concerning the Young's modulus, because the paragraphs only teach a preferable thickness of a copper foil to be used as a copper foil with an adhesive, an adhesive composition (Example 1), and formation of a clad laminate with the use of the adhesive composition, the 35μm-electrodeposited copper foil, and the glass epoxy prepreg. Thus, Saida only teaches a general method of producing a clad laminate, an adhesive to be used for a substrate, or a copper foil with an adhesive, and there is no teaching about a physical property of copper foils to be positioned on the both sides of the double-sided copper clad laminate or a relationship between the first and second copper foils.

Applicants, therefore, submit that claims 5-7, 10-13, 16-19, and 22 are not anticipated by Saida. Applicants respectfully request that the rejection on this basis be withdrawn.

***Claim Rejections under 35 U.S.C. §103***

Claims 8, 9, 14, 15, 20 and 21 are rejected under 35 U.S.C. §103(a) as being unpatentable over Saida. The Examiner argues that Saida discloses a second copper foil contracting at a certain percentage under pressing conditions of 170 degrees Celsius and 60 minutes but admits that Saida does not explicitly disclose that the second copper foil contracts about 0.05% under pressing conditions of 180 degrees Celsius and 1 hour. However, the Examiner argues that there is no evidence indicating the contracting percentage and the pressing conditions range of the second copper foil are critical and refers to the MPEP as stating that it is not inventive to discover the optimum or workable percentage/range of a result-effective variable within given prior art conditions by routine experimentation. The Examiner also argues that the specification contains no disclosure of either the critical nature of the claimed dimensions or any unexpected results. Where patentability is said to be based upon particular chosen dimensions or upon a variable recited in a claim, the Examiner argues that the applicant must show that the chosen

dimensions are critical. Finally, the Examiner argues that it was well-known to one or ordinary skill in the art at the time of the invention was made that the second copper foil may be a S-HTE foil.

Applicants respectfully disagree that claim 8, 9, 14, 15, 20, and 21 are unpatentable over Saida. These claims are dependent on claims 5, 11, and 17 and incorporate all their limitations. As Applicants assert that claims 5, 11, and 17 are in condition for allowance, Applicants also submit that claims 8, 9, 14, 15, 20, and 21 are also patentable. Furthermore, nowhere does Saida disclose or suggest that a second copper foil with a thickness greater than that of a first copper foil contracts to a larger extent than the first copper foil during hot pressing. The contraction properties disclosed and claimed in the present invention are the opposite from what one of ordinary skill in the art would expect. Nowhere does Saida teach that the first copper foil is not recrystallized during hot pressing and the second copper foil is recrystallized during hot pressing. Applicants submit there is no teaching or even a hint that would allow a person of ordinary skill in the art to achieve the invention as claimed in the present invention. Pages 9-10 of the specification indicate that a thicker copper foil is expected to contract more than a thinner copper foil. This leads to warping in a copper clad laminate with copper foils of different thicknesses. When the laminate of the copper foil/insulation layer constituent material/copper foil structure is hot-pressed, each layer can freely expand or contract to an extent determined by quantity of heat supplied, so long as it remains liquid before the insulation layer constituent resin is cured. But the expansion or contraction behavior is limited resulting from differences between the adjacent layers in thermal expansion or contraction as the insulation layer constituent resin is cured. (*See* Specification page 5). The present invention remedies potential warping by lowering the Young's modulus of the thicker copper foil to minimize its contraction in relation to the thinner copper foil. When thermally treated under the conditions of 180 degrees Celsius and 1 hour, the S-HTE foil has a lower Young's modulus of around 40 to 50 GPa as compared with around 55 to 60 GPa of the copper foil common in the art.

In summary, Saida is completely silent and provides no motivation or suggestion to arrive at the present invention. Saida is silent as to a second copper foil having a thickness greater than that of a first copper foil thereby allowing the second copper foil to contract to a larger extent than the first copper foil during hot pressing. Saida also fails to suggest not recrystallizing the first copper foil during hot pressing, but recrystallizing the second copper foil during hot pressing. Because there is no suggestion or teaching in Saida to allow one of ordinary skill in the art to arrive at the present invention, Applicants submit that claims 8, 9, 14, 15, 20, and 21 are not obvious in view of Saida. Applicants, therefore, respectfully request that the rejection on this basis be withdrawn.

In view of the above remarks, Applicants submit that the present application is now in condition for allowance. Reconsideration and favorable action are requested. The Examiner is invited to telephone the undersigned to expedite allowance of this application.


| RESPECTFULLY SUBMITTED, | | | | | |
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INTRODUCTION TO

SECOND EDITION

# Materials Science FOR Engineers

James F. Shackelford

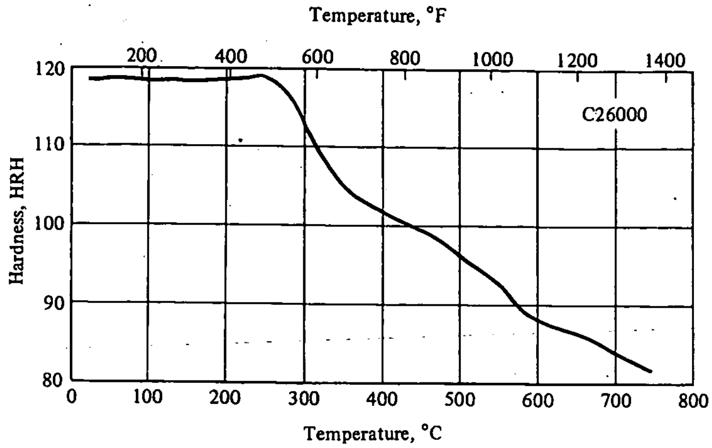


**FIGURE 6.5-3** The sharp drop in hardness identifies the recrystallization temperature as ~290°C for the alloy C26000, "cartridge brass." (From *Metals Handbook*, 9th ed., Vol. 4, American Society for Metals, Metals Park, Ohio, 1981.)

## c Recrystallization

In Section 4.3a we stated an important concept: "The temperature at which atomic mobility is sufficient to affect mechanical properties is approximately one-third to one-half times the absolute melting point, $T_m$." A microstructural result is termed "recrystallization" and is illustrated dramatically in Figure 6.5-2(a)–(d). New equi-axed, stress-free grains nucleate at high-stress regions in the cold-worked microstructure [part (b)]. These grains then grow together until they constitute the entire microstructure [parts (c) and (d)]. As the nucleation step occurs in order to stabilize the system, it is not surprising that the concentration of new grain nuclei increases with the degree of cold work. As a result, the grain size of the recrystallized microstructure decreases with the degree of cold work. The decrease in hardness due to annealing is substantial, as indicated by Figure 6.5-3. Finally, the rule of thumb quoted at the beginning of this discussion of recrystallization effectively defines the *recrystallization temperature* (see Figure 6.5-4). For a given alloy composition, the precise recrystallization temperature will depend slightly on the percentage cold work. Higher values of % CW correspond to higher degrees of strain hardening and a correspondingly lower recrystallization temperature, that is, less thermal energy input is required to initiate the reformation of the microstructure (see Figure 6.5-5).

## d Grain Growth

The microstructure developed during recrystallization [Figure 6.5-2(d)] occurred spontaneously. It is "stable" in comparison to the original cold-worked structure [Figure 6.5-2(a)]. However, the recrystallized microstructure contains a large concentration of grain boundaries. We have noted frequently since Chapter 4 that the reduction of these high-energy interfaces is a method of stabilizing a system further. The stability of coarse pearlite (Figure 6.2-5) was such an example. The coarsening of annealed